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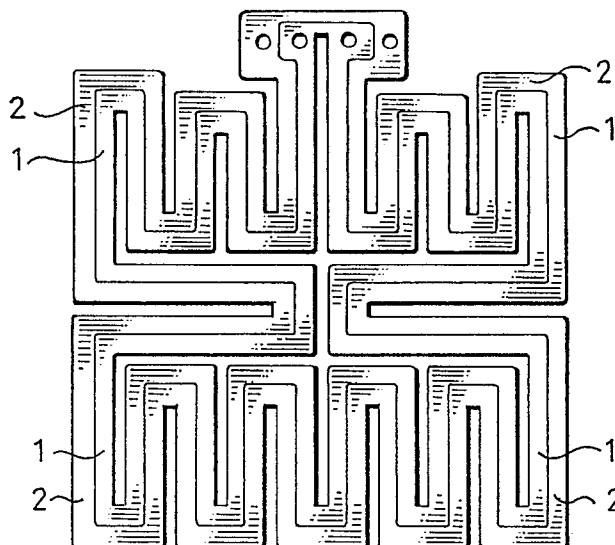
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⑥④ **Method of manufacturing loop-formed metal foil elements.**

⑥⑦ Method to manufacture two loop-formed metal foil elements (1, 2) intended to serve as electrical resistance heating elements. Starting from a unitary metal foil, possibly enclosed by plastic foils, at least two complementarily extending loop elements, one (1) inside the other (2), are punched at the same time.



METHOD OF MANUFACTURING LOOP-FORMED METAL FOIL ELEMENTS

5 The present invention relates to a method of manufacturing loop-formed metal foil elements intended to serve as electrical resistance heating elements.

10 Such metal foil elements are known, e.g., from SE-A-7713250-4, and are being used more and more for various heating purposes, e.g. for heating car seats or other flexible surface elements, or for heating rigid surfaces, possibly having a complicated geometrical, in particular curved shape. For such purposes, it is usually essential that the loop-formed metal foil element covers a relatively large surface area, although for
15 one reason or another the mutually adjacent parts of the loop element should preferably be well separated from each other, e.g. to enable stretching during assembly or use of the element.

20 The manufacture of such loop elements with relatively sparsely distributed loop portions has hitherto involved a great waste of material, since the material between the loop portions was discarded. Moreover, conventional methods of printing and etching of loop patterns are extremely complicated
25 and cumbersome.

The object of the invention is to achieve a manufacturing method in which the waste of material is considerably reduced and, moreover, permitting an especially simple method,
30 namely punching.

Starting from a unitary metal foil, this object is achieved by simultaneously forming, particularly by punching, at least two complementarily extending loop elements, one inside the
35 other. In this connection, it has rather surprisingly turned out that the difference in length, and thus in resistance,

of two adjacent meander-shaped loop elements of the same width only amounts to a few percent, and such loop elements can therefore be used for the same purpose, e.g. in car seats.

5 In practice, two or three loop elements, located one inside the other, can be formed at the same time, but in principle, even four or more loop elements may be produced. Already in case of two complementary elements, the material can be used up to about 70-80%, which means a considerable economic saving
10 compared to conventional manufacturing methods. Moreover, the waste obtained when forming by punching is more favourable for re-use than by etching.

Thus, the loop elements located inside each other will be
15 approximately equal in length. If so desired, the actual differences in length, which are small, may be compensated by making the shorter loop elements somewhat narrower so that the resistance becomes equal.

20 From the point of view of productivity, it is advantageous to punch a laminate consisting of the metal foil itself and two cover foils of thermoplastic material, e.g. polyester, on each side thereof, the two cover foils being stretched over the edges of the metal foil loop elements and being joined
25 along these edges under the influence of heat, so that the metal foil loop elements are entirely closed by the cover foils. The joining can possibly be effected during the punching operation by an adjusted design and heating of the punching tools.

30 Suitably, the punching is performed by means of stamp and die, but principally, even a cutting punch can be used. A possible alternative to the punching operation is conventional production by etching the loop elements located inside each
35 other. In such a case, a metal foil is applied to a supporting layer, preferably of thermoplastic material, such as polyester, and after etching the complementary loop elements a cover layer may be applied. Thereafter, the loop elements are

punched out together with the metal foil loops enclosed between the enclosing layers.

The invention will be described further below with reference
5 to the appended drawing, which illustrates a simple embodiment.

Fig. 1 shows in a planar view two foil loops, one inside the other, which have been punched out from a unitary foil laminate; and

10

Figs. 2 and 3 show each of the two loop elements separately.

The embodiment illustrated in Fig. 1 consists of two foil loop elements 1,2 located one (element 1) closely inside the
15 other (element 2) and having complementary meander loop portions, also shown in Figs. 2 and 3, illustrating the configuration of each loop element 1,2. As is known from SE-A-7713250-4 and SE-A-8205712-6 the different loop portions extend in different main directions, i.e. substantially
20 perpendicular to each other.

With such an arrangement, it has turned out that the difference in resistance between the elements 1,2 in Figs. 2 and 3 is only about 2%.

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In the example the metal foil is made of a rust-proof plate material having a thickness of about 35 μm . The metal foil is enclosed at both sides by polyester plastic which is punched simultaneously in one operation by means of a punch
30 tool formed in correspondance to the configuration shown in Fig. 1.

In general, the metal foil may have a thickness of 20-100 μm . If three loop elements are punched out at the same time, the
35 thickness should be larger than the thickness of only two coil members, e.g. about 50 μm .

In the embodiment the punched out loop elements are short-circuited by a metal connection C1 (Fig. 2) and C2 (Fig.3), respectively. The purpose of this connection is to make the element stable enough during the assembly of the connection cables and an outer casing, e.g. in the form of a plastic net. Thereafter, the connection is cut away. As an alternative to such metal connections, one of the plastic foils, e.g. the lower one, may have larger dimensions than the metal foil and the other plastic foil, so that a protruding plastic foil portion (not to be punched) constitutes the desired connection, which provides the member with the necessary stability during assembly.

Of course, the form of the loop may vary at wish in view of the intended use. Thus, the meander loops may extend in mutually oblique main directions or in only one main direction. The loop elements do not necessarily have to be meander-shaped, but may have any, preferably closed configuration. The essential feature is that the loop elements are situated complementarily one inside the other and together cover the major part of the surface area in question so as to reduce the waste of material.

C L A I M S

1. A method to manufacture loop-formed metal foil elements (1,2) intended to serve as electrical resistance heating elements, characterized in that starting, from a unitary metal foil, at least two complementarily extending loop elements, one (1) inside the other (2), are formed simultaneously.
2. A method according to claim 1, characterized in that the loop elements (1,2) are formed by punching.
3. A method according to claim 2, characterized in that a laminate, consisting of said metal foil and at least one electrically insulating layer, is punched.
4. A method according to claim 3, characterized in that a laminate consisting of said metal foil and two cover foils of thermoplastic material, arranged on both sides thereof, are punched, wherein the two cover foils are stretched over the edges of the metal foil loop elements and are joined along these edges under the influence of heat, so that the metal foil loop elements are entirely enclosed all around by the cover foils.
5. A method according to claim 4, characterized in that said joining under the influence of heat is effected during the punching operation.
6. A method according to claim 1, characterized in that the loop elements are formed by etching, starting from a laminate consisting of said metal foil and a support layer.

Fig. 1

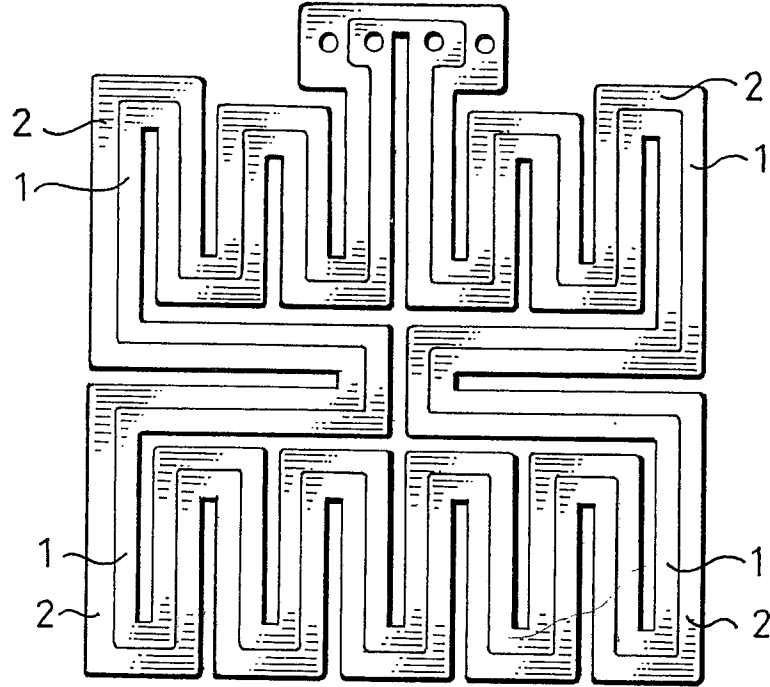


Fig. 3

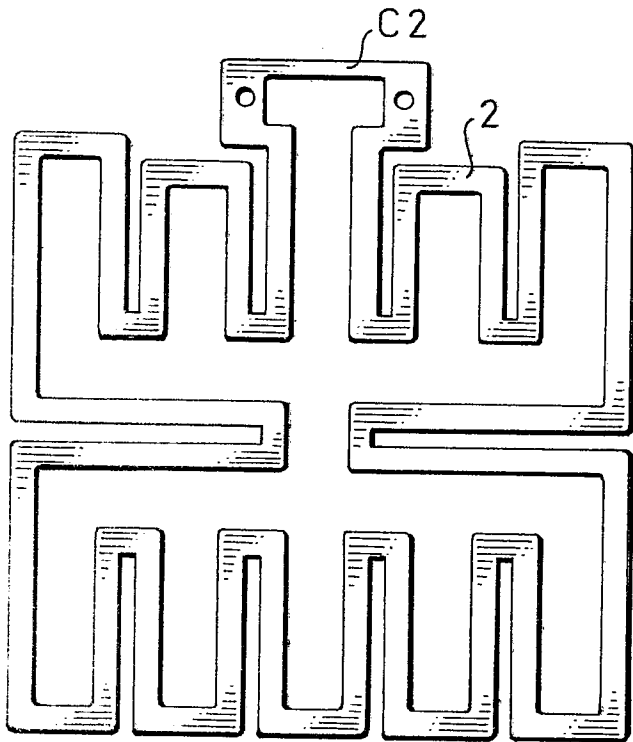
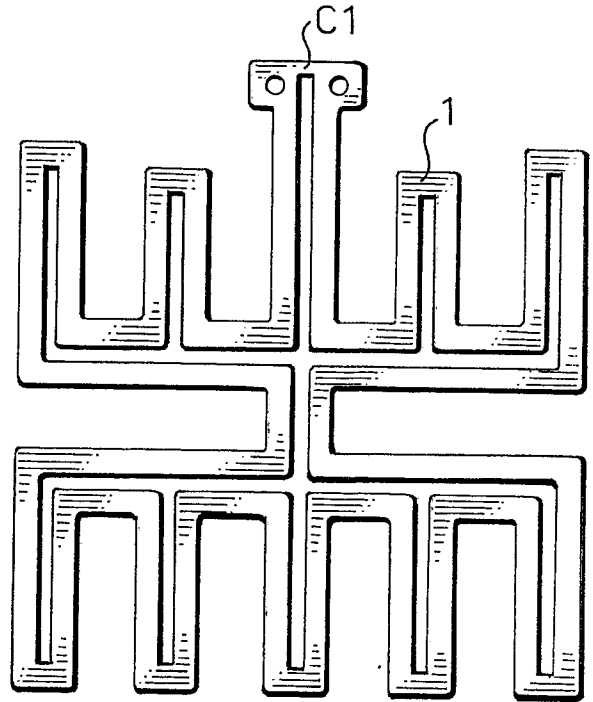


Fig. 2





DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	US-A-3 495 328 (ZIVER) * Column 4, last paragraph; column 5, paragraph 2; figure 2 *	1,2,4	H 05 B 3/34 H 05 B 3/26
A	GB-A- 912 980 (EISLER) * Page 8, line 115 - page 9, line 39 *	1-5	
A	US-A-4 378 489 (CHABINSKY et al.) * Column 2, lines 4-36; figure 1A *	1	
A	EP-A-0 028 494 (LINTON & HIRST) * Page 4, lines 4-23 *	1,2	
A	DE-A-2 615 064 (HUSQVARNA) * Page 4, last paragraph; page 5, lines 1-7 *	1-3,6	TECHNICAL FIELDS SEARCHED (Int. Cl.4)
A	US-A-4 002 883 (HURKO)		H 05 B 3/00 H 01 C 3/00
A	US-A-4 063 068 (JOHNSON et al.)		
A	US-A-4 057 707 (ALLEN)		
	--- -/-		
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 05-12-1985	Examiner RAUSCH R.G.
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons</p> <p>& : member of the same patent family, corresponding document</p>			



DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	EP-A-0 024 319 (FA. H. SCHWABE) -----		
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 05-12-1985	Examiner RAUSCH R.G.
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document</p>			